

# EMC FWEC Calibration Setup at COSY

Lukas Linzen

Ruhr-Universität Bochum  
Institut für Experimentalphysik I

Collaboration Meeting  
EMC Session  
01.06.2022

RUHR  
UNIVERSITÄT  
BOCHUM

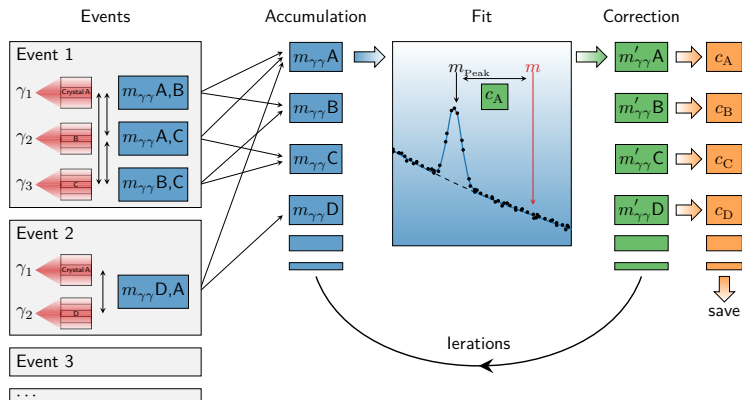
RUB



# Precalibration Overview

- initial calibration with cosmic rays in Bonn
- aim at COSY is twofold
  - test the fully assembled FWEC
  - pre-calibrate FWEC for  $\bar{P}$ ANDA
- calibration with  $\pi^0$  decays into  $2\gamma$
- $p^+$ -beam at COSY will be used
- target of light nuclei is planned

# Calibration Algorithm

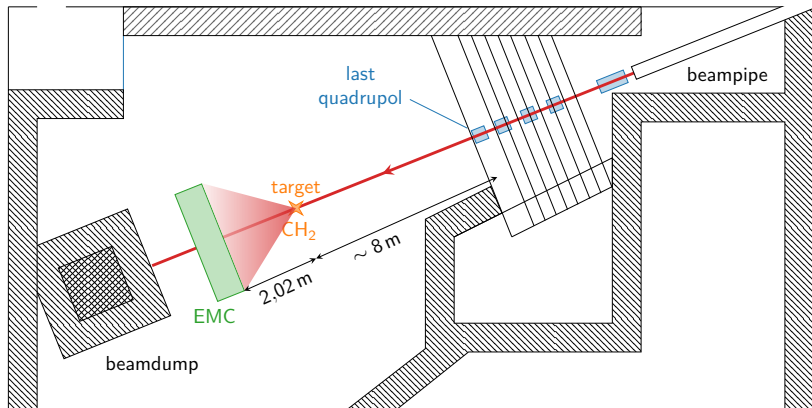


- $$m_{\gamma_1\gamma_2}^2(\pi^0) = f(E(\gamma_1), E(\gamma_2), \theta_{12})$$

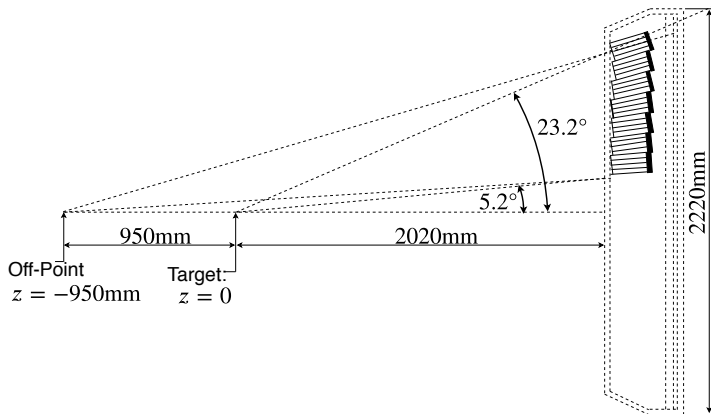
## Calibration at COSY

- simulations suggest that higher energies are preferable considering calibration time and range of  $\gamma$ -energies
- highest energy available at external experimental setups of  $\sim 2,5$  GeV will be used
- $p^+$  rate up to  $10^9 \text{ s}^{-1}$ 
  - leads to luminosity of up to  $10^{30} \text{ cm}^{-2} \text{ s}^{-1}$
  - $\sim 50\%$  events result in hits in the FWEC
  - usable rate will depend on bandwidth of readout system
- beam diameter in order of 1 cm
- expected time of data taking with a rate of  $10^3 \text{ s}^{-1}$  in the order of 55 h

# Setup in Time of Flight (ToF) Hall



# Target

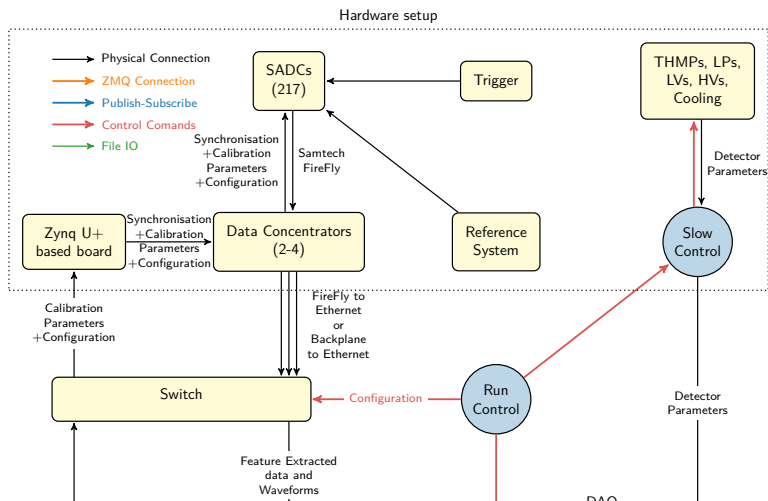


- PET-foil of  $\sim 200\ \mu\text{m}$
- target position same as in  $\overline{\text{PANDA}}$

## Proposed Hardware Setup

- 3856 crystals read out by 6176 APDs and 768 VPTTs
- 6944 channels
- readout by 217 SADCs (32 channels each) connected to 4 data concentrators
  - data concentrators send data to PC over fibre connections
  - synchronisation of SADCs with Aurora Sync instead of SODA to ensure fast development
  - storage in readout server as SSD or HDD array depending on size and bandwidth requirements

# Hardware Test for PANDA



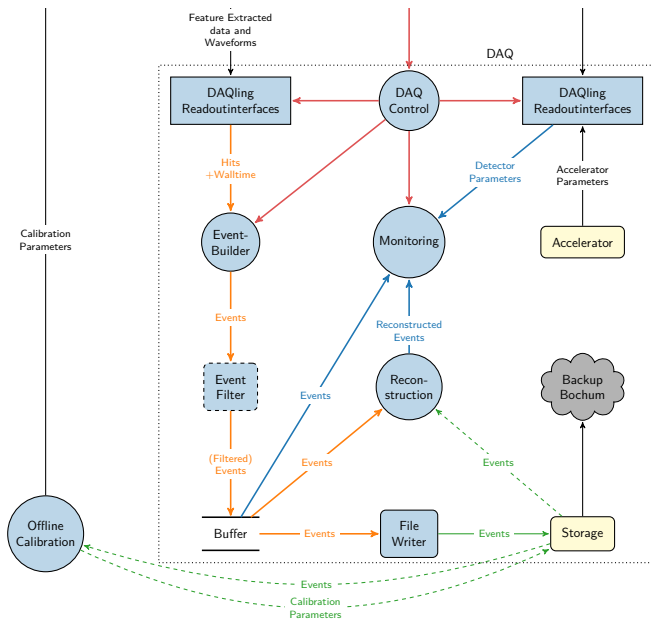


## Proposed Hardware Setup

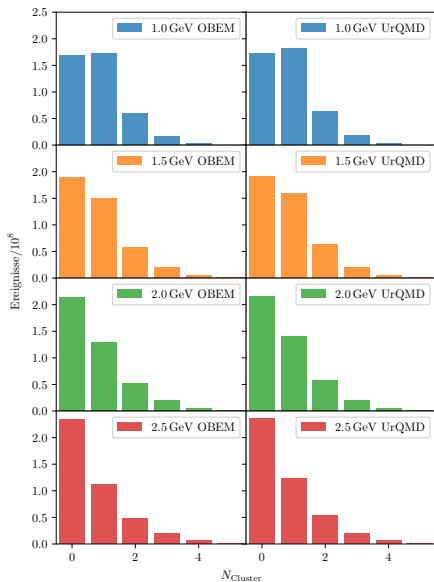
- SADCs in crates in detector frame
  - 10 crates for 15 SADCs
  - 12 crates for 6 SADCs
- ISEG high voltage in 7 10 slot crates
  - 8 modules with 16 channels at 2 kV for VPTTs
  - 8 modules with 8 channels at 2 kV for VPTTs
  - 49 modules with 16 channels at 1 kV for APDs
- 4 Wiener PL-512 low voltage PSUs

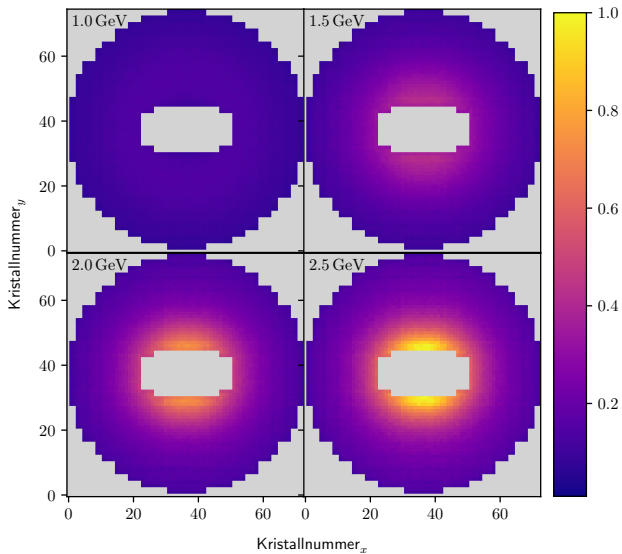
## Tracking or Veto Detector

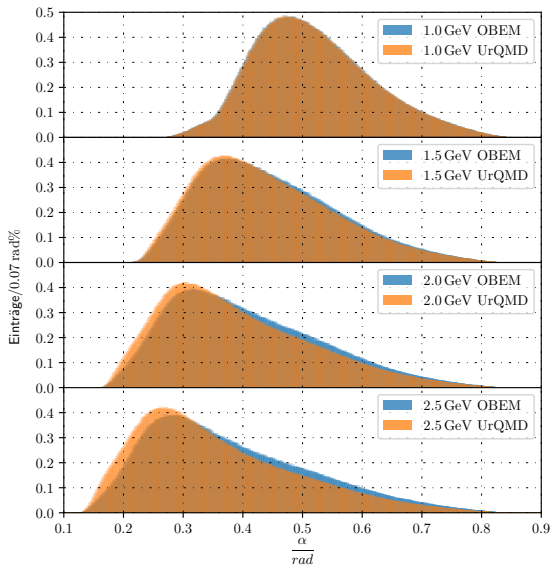
- tracking detector would be helpful with checking crystal positions and triggering
- alternatively simple veto detector to reduce data rate could be used
- could be read out by SADCs to ensure streamlined readout



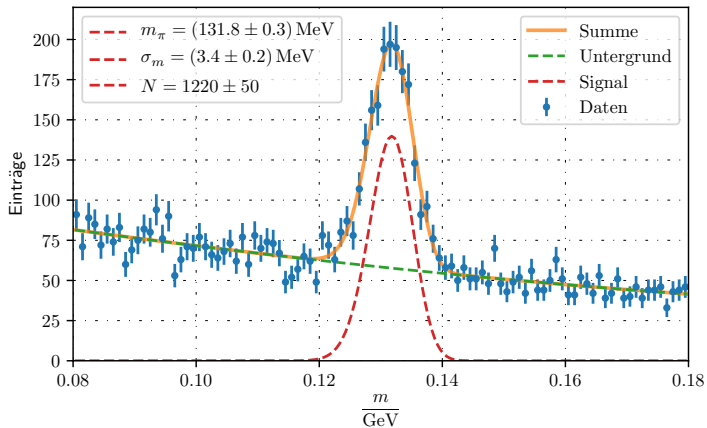
Thank you for  
your attention!





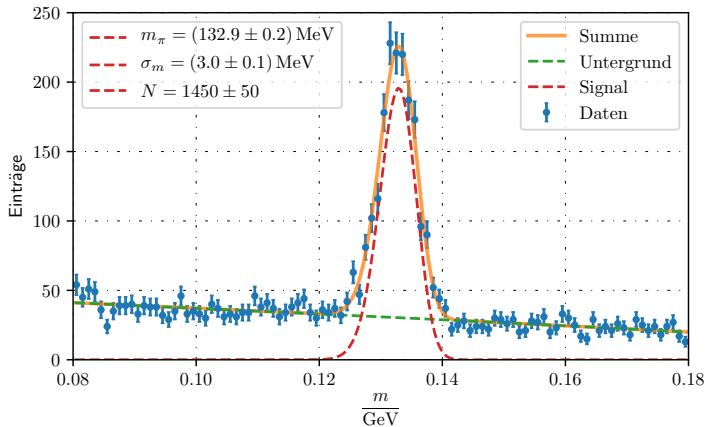


# Spectrum of outer Crystal (2,5 GeV)

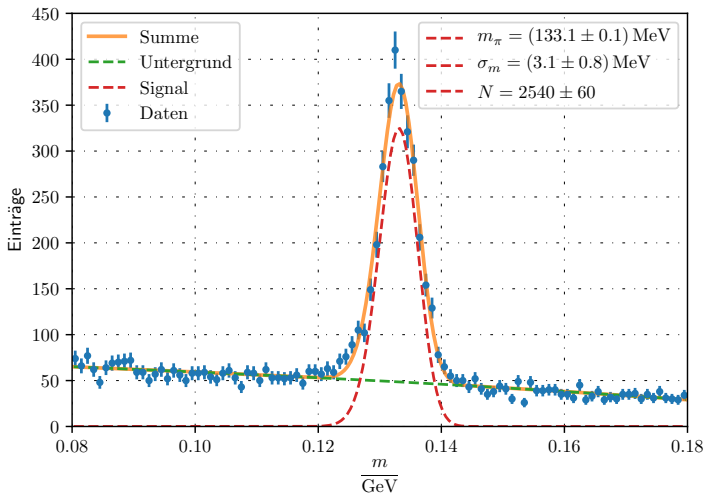




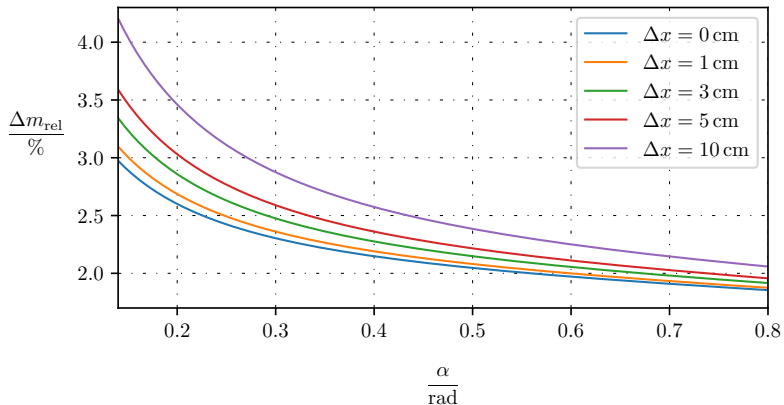
# Spectrum of middle Crystal (2,5 GeV)



# Spectrum of inner Crystal (2,5 GeV)



# Error in Mass Calculation from Beam diameter



## Simulation Overview

- EvtGen as event generator
- $\bar{\text{PANDARoot}}$  with FWEC as only detector
- $4 \cdot 10^8$  events simulated
- approximation of pC-scattering as scaled p(p+n)-scattering

$$m_{\pi^0} = 4E_1 E_2 \sin^2(\theta_{12}/2)$$

$$m_{\pi^0} \simeq 135 \text{ GeV}/c^2$$